REMARKS

Applicants are amending their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 1 to recite "location" of the first and second circuit electrodes, and have further amended claim 1 to recite that insulating layers of silicon dioxide or silicon nitride are located adjacent to at least one of the first circuit electrodes and the second circuit electrodes. Claim 1 has been further amended to recite that the conductive particles have a hardness of 4.4413-6.865 GPa. As to recitation of material of the insulating layers, note, for example, paragraph [0054] on pages 23 and 24 of Applicants' specification. As to the hardness of the conductive particles, note, for example, conductive particles No. 2 and No. 15 as set forth in Tables 1 and 2 on page 50 of Applicants' specification. Applicants have similarly amended claim 19 to recite "location" of the first and second circuit electrodes, and to recite material of the insulating layers, with such insulating layers being located adjacent to at least one of the first and second circuit electrodes.

In addition, Applicants are adding new claims 20-25 to the application. Claims 20 and 21, dependent respectively on claims 1 and 19, recite that the insulating layers are located adjacent to both the first and second circuit electrodes. Claims 22 and 23, each dependent on claim 19, respectively recites a difference in thickness between the first and second circuit electrodes and any insulating layer adjacent thereto; and recites that the film-form circuit connecting material interposed between the main surfaces of the first and second circuit boards has a thickness of 10-50 μm. Claims 24 and 25, dependent respectively on claims 6 and 1, respectively further defines the glass transition temperature and the storage elastic modulus of the circuit connecting material.

In connection with the newly added claims, note, for example, previously considered claims 1 and 19, and see also paragraph [0053] on page 23, paragraph [0060] bridging pages 26 and 27, and paragraphs [0070] and [0071] on pages 31 and 32, of Applicants' specification.

The indication by the Examiner in the first paragraph on page 2 of the Office Action mailed February 17, 2009, that Applicants have not filed a certified copy of the Japanese priority application No. 2003-181593 "as required by 35 U.S.C. 119(b)", is noted. However, it is respectfully submitted that Applicants need not file such certified copy in the above-identified application, which is a National Stage application filed under 35 USC 371. In connection therewith, attention is respectfully directed to the PCT Notification Concerning Submission of Transmittal of Priority Document mailed September 15, 2004, in connection with International (PCT) Application No. PCT/JP2004/008896, notifying Applicant of the date of receipt by the International Bureau of the priority document relating to all earlier applications whose priority is claimed. A copy of this Notification was submitted in the above-identified National Stage application, upon original filing thereof. Note that, as seen in this Notification, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b). In view thereof, it is respectfully submitted that the priority document is to be transmitted from the International Bureau in this National Stage application, and Applicants need not file a certified copy of the priority application No. 2003-181593.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed February 17, 2009, that is, the teachings of European Patent Application No. 979854 to Watanabe, et al., European Patent Application No. 996321 to Yamada, et al., and

Japanese Patent Document No. 2001-189171 to Suga, et al., under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither disclosed nor would have suggested such a circuit connecting material as in the present claims, including, inter alia, wherein the material includes conductive particles which have a hardness of 4.4413-6.865 GPa, and wherein the material exhibits a storage elastic modulus of 0.5-3 GPa at 40°C and a mean coefficient of thermal expansion of 30-200 ppm/°C at from 25°-100°C. See claim 1.

In this regard, note that, as will be discussed in more detail infra, such material can be used to connect first and second circuit electrodes located on surfaces of respective circuit boards having insulating layers of silicon dioxide or silicon nitride adjacent the circuit electrodes, with at least some of the insulating layers being formed such that the insulating layers are thicker than the circuit electrodes.

Furthermore, it is respectfully submitted that these references would have neither disclosed nor would have suggested such circuit connecting material as in the present claims, having conductive particles with a hardness, the material having a storage elastic modulus and mean coefficient of thermal expansion, as discussed previously in connection with claim 1, and, additionally, wherein the insulating layers having the differential thickness are located adjacent both the first and second circuit electrodes (note claim 20); and/or structure of the conductive particles, and material thereof, as in claims 2 and 3; and/or material of the bonding agent composition of the circuit connecting material, as in claims 4 and 5; and/or glass transition temperature of the circuit connecting material, as in claim 6, and as more particularly defined in claim 24; and/or further definition of the storage elastic modulus as in claim 25.

Furthermore, it is respectfully submitted that the teachings of these applied references would have neither disclosed nor would have suggested such circuit connecting material as in the present claims, having features as discussed in connection with claim 1, and, additionally, wherein the circuit connecting material further contains a film forming material (see claim 7), in particular wherein such film forming material is a phenoxy resin (see claim 8); and/or the film-form circuit connecting material formed by forming the circuit connecting material according to claim 1 into the shape of a film (see claim 9).

Additionally, it is respectfully submitted that these references as applied by the Examiner would have neither disclosed nor would have suggested such a method for manufacturing a circuit member connecting structure which includes first and second circuit members respectively having first and second circuit members on main surfaces thereof, the first and second circuit members respectively having first and second circuit electrodes, and wherein insulating layers of silicon dioxide or silicon nitride are located adjacent to at least one of the first circuit electrodes and the second circuit electrodes and at least some of the insulating layers being formed so that these layers are thicker than the circuit electrodes, with the film-form circuit connecting material according to claim 9 being interposed between main surfaces of the first and second circuit boards and curing the circuit connecting material by application of heat and pressure so that the first and second circuit electrodes are electrically connected via conductive particles of the film-form circuit connecting material. See claim 19.

Furthermore, it is respectfully submitted that the teachings of these applied references would have neither disclosed nor would have suggested such method as in the present claims, having features as discussed previously in connection with claim 19, and, additionally, wherein the insulating layers having the greater thickness

are located adjacent to both the first and second circuit electrodes (see claim 21); and/or difference in thickness between the insulating layer and adjacent first and second circuit electrodes, as in claim 22; and/or thickness of the film-form circuit connecting material as in claim 23.

Initially, attention is respectfully directed to the "Claim Interpretation" on page 3 of the Office Action mailed February 17, 2009. In particular, the contention by the Examiner that the language "for manufacturing . . . so that these layers are thicker than said circuit electrodes on the basis of the main surface of the circuit board in at least one of said first and second circuit members" in claim 19 has been given little patentable weight because the recitation occurs in the preamble", is noted. However, note that in claim 19, in the method steps, "the main surface of said first circuit board and the main surface of said second circuit board", and "said first and second circuit members", are also recited. Especially in view thereof, it is respectfully submitted that the first and second circuit members and circuit electrodes thereof, and the first and second circuit boards, as recited in claim 19 form part of the recited method, and must be fully considered in determining patentability.

Emphasizing recitation of insulating layers in claim 19, which form part of the structure connected by practicing the recited method, it is respectfully submitted that the structure being used in the recited method steps must be considered in determining patentability of the claimed method. As will be discussed in the following in detail, it is respectfully submitted that the teachings of the applied references do not disclose, nor would have suggested, problems arising in connection with connecting structure as in the present claims, having insulating layers of silicon dioxide or silicon nitride thicker than the circuit electrodes (and thus projecting to a higher level than such electrodes), and avoiding such problems

utilizing the conductive particles and bonding agent composition of the present claims.

Thus, the invention as being considered on the merits in the above-identified application is directed to a circuit connecting material, film-form circuit connecting material utilizing such circuit connecting material, and a method of manufacturing a circuit member connecting structure utilizing such film-form circuit connecting material.

Circuit member connecting structures used for the mutual connection of circuit members such as liquid crystal displays, tape carrier packages, flexible printed circuits, and printed wiring boards, among other uses, have been known in the past. Circuit connecting materials in which conductive particles are dispersed in a bonding agent have been proposed for the connection of circuit members, as described in paragraph [0002] on page 1 of Applicants' specification.

However, as circuits have been formed with progressively higher densities, so that spacing between circuit electrodes and the width of circuit electrodes have become narrow, it is has become difficult to ensure high insulating properties between adjacent circuit electrodes on a surface, and it has been considered necessary to form an insulating layer comprising, e.g., silicon dioxide or silicon nitride between the adjacent circuit electrodes.

In providing structure having such insulating layers, portions of the insulating layer ride over the edges of the circuit electrodes; and, specifically, as described in the sentence bridging pages 2 and 3 of Applicants' specification, in connection with Fig. 7 of Applicants' original disclosure, portions of the insulating layers 134 are formed with a greater thickness than the circuit electrodes 133 on the basis of the surface 132a of the circuit board 132. Various problems arise in connection with such structure. For example, connection resistance between the facing circuit

electrodes is large, and long-term reliability of the electrical characteristics is insufficient.

Against this background, Applicants provide a circuit connecting material that can sufficiently reduce connection resistance between facing circuit electrodes, and that is superior in terms of long-term reliability of electrical characteristics. As a result of diligent research by the present inventors, the present inventors have found that hardness of the conductive particles is an issue in connection with the circuit connecting material. Specifically, as described in paragraph [0008] bridging pages 4 and 5 of Applicants' specification, the present inventors discovered that if the hardness of the conductive particles is excessively large, the conductive particles become caught between the insulating films that ride over the edges of the circuit electrodes, so that the conductive particles do not make sufficient contact with both of the facing circuit electrodes; and that, as a result of this, the connection resistance between the facing circuit electrodes in increased. See, e.g., Fig. 7 of Applicants' disclosure.

Having discovered the source of this problem, the present inventors discovered that by utilizing a bonding agent composition and conductive particles as in the present claims, the conductive particles having a mean particle size <u>and hardness</u> as in the present claims, with the material exhibiting a storage elastic modulus and mean coefficient of thermal expansion as in the present claims, objectives according to the present invention are achieved; and, in particular, a circuit connection can be achieved having reduced connection resistance and long-term reliability of the electrical characteristics. As described in paragraph [0011] on page 6 of Applicants' specification, even if conductive particles become caught between the insulating layers that face each other, with use of conductive particles having a hardness as in the present claims the conductive particles are appropriately

flattened so that the distance between the facing circuit electrodes can be sufficiently reduced. See, e.g., Figs. 1 and 2 of Applicants' disclosure. Moreover, as the circuit members are firmly connected by the curing treatment of the circuit connecting material, so that variation in distance between the first and second circuit electrodes over time can be sufficiently reduced, superior long-term reliability of electrical characteristics is achieved.

In particular, as described in paragraphs [0041] and [0042] on pages 17 and 18 of Applicants' specification, and as continued in paragraph [0043] thereof, by incorporating conductive particles having a hardness of a maximum of 6.865 GPa, the conductive particles can be sufficiently flattened so as to avoid increase in electrical resistance. Furthermore, by utilizing the material having storage elastic modulus and mean coefficient of thermal expansion as in the present claims, an increase in connection resistance in the connecting parts as a result of internal stress, and peeling away of the bonding agent, can be avoided. Note also paragraph [0065] on page 29, and paragraph [0069] bridging pages 30 and 31, of Applicants' specification.

Furthermore, by utilizing a circuit connecting material having a glass transition temperature as in various of the present claims, a reduction in bonding strength at high temperature and a rise in connection resistance can be avoided, and internal and interfacial stresses in the circuit connecting member, which can cause cracking to occur and a reduction in bonding strength, can be avoided.

As to advantages achieved according to the present invention, attention is respectfully directed to the results of examples as set forth in Table 3 on page 58 of Applicants' specification, and the discussion in connection therewith in paragraphs [0136]-[0138] on pages 58 and 59 of Applicants' specification. In connection with these examples, note description of the Examples on pages 50-54 of

Applicants' specification; and description of the hardness of the conductive particles in Tables 1 and 2 on page 50 of Applicants' specification. Note particularly the discussion in paragraph [0138] on page 59 of Applicants' specification, that where the conductive particles used were too hard, sufficient flattening of the conductive particles could not be obtained, and there was a rise in the connection resistance following the high-temperature, high-humidity treatment.

It is respectfully submitted that the evidence in Applicants' specification must be considered in determining patentability of the presently claimed subject matter. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984).

In addition, attention is respectfully directed to the enclosed Additional Examples 1 and 2, Additional Reference Example 1 and Additional Comparative Examples 1 and 2, and the enclosed Table I showing bonding strength, storage elastic modulus and mean coefficient of thermal expansion of the Examples and Comparative Examples in Applicants' original disclosure and the aforementioned Additional Examples 1 and 2, Additional Reference Example 1 and Additional Comparative Examples 1 and 2; as well as the enclosed Table II showing connection resistance and number of conductive particles utilizing film-form circuit connecting material from the material of the aforementioned Additional Examples 1 and 2, Additional Reference Example 1 and Additional Comparative Examples 1 and 2, and the enclosed Table III showing connection resistance and number of conductive particles for connecting structure of the present invention suing materials of the Additional Examples, Reference Example and Comparative Examples. Particularly as can be seen in Tables II and III, in Additional Reference Example 1 the connection resistances were higher than that of the Additional Examples, due to the hardness of Conductive Particles No. 18 being lower than 4.4413 GPa; and in Additional Comparative Example 2, connection resistances were higher than that of

the Additional Examples, because the mean coefficient of thermal expansion was higher than 200 ppm/°C.

These Additional Examples, Additional Reference Example and Additional Comparative Examples, especially taken together with the experimental data in Applicants' specification, show unexpectedly better results achieved according to the presently claimed subject matter, as compared with materials outside the scope of the present claims.

Watanabe, et al. discloses circuit-connecting material interposed between circuit electrodes facing each other and electrically connecting the electrodes in the pressing direction, the circuit-connecting material comprising as essential components a curing agent capable of generating free radicals upon heating, a hydroxy-group-containing resin having a molecular weight of 10,000 or more, and a radical-polymerizable substance. Note paragraph [0007] on page 2 of this patent document. Note also paragraphs [0013], [0015] and [0017] on page 3 of this patent document, the latter paragraph describing a circuit terminal connecting method. Note also paragraph [0022] on page 4 of this patent document. In paragraph [0082] on page 14 of this patent document, there is a disclosure of use of conductive particles which may include particles of metal such as Au, Ag, Ni, Cu and solder or carbon, or particles comprising non-conductive glass, ceramic or plastic and on which conductive layers have been formed by coating; and a disclosure that in a case of heat-fusion metal particles, the particles are deformable upon heating and pressing and hence can have a larger area of contact with electrodes at the time of connection, bringing about an improvement in reliability. Note also paragraph [0107] on page 16 of this patent document, disclosing conductive particles of 10 μm in average particle diameter; and paragraphs [0124]-[0127] on page 17 of this patent document, disclosing conductive particles with particle diameters of, e.g., 5 μm.

It is respectfully submitted that this reference does not disclose, nor would have suggested, such circuit connecting material as in the present claims, including, inter alia, hardness of the conductive particles as in the present claims, much less storage elastic modulus and mean coefficient of thermal expansion of the material, together with hardness of the conductive particles, as in the present claims, and advantages thereof as discussed in the foregoing.

The contention by the Examiner in the paragraph bridging pages 4 and 5 of the Office Action mailed February 17, 2009, is respectfully traversed. Initially, it is respectfully submitted that the Examiner has not established that the components, including hardness, of the conductive particles and storage elastic modulus and mean coefficient of thermal expansion, or glass transition temperature, in Watanabe, et al., are the same as that in the present claims. It is respectfully submitted that the Examiner has not established a prima facie case of either anticipation or obviousness.

Moreover, Applicants respectfully traverse the contention by the Examiner in the second full paragraph on page 5 of the Office Action mailed February 17, 2009. Clearly, as can be seen in Fig. 1 of Watanabe, et al., the circuit electrodes project from the substrate, without an insulating layer with a greater thickness. Clearly, the Examiner errs in contending that the composition and components of Watanabe, et al. have the same utility as the circuit connecting material of the present claims, and errs in contending that the composition of Watanabe, et al. has the same common utility as in the present claims.

Yamada, et al. discloses an anisotropically electroconductive adhesive for electrically connecting and mechanically binding electric lines or circuits confronting to each other, which comprises an electrically insulating adhesive matrix and electroconductive particles dispersed in the matrix, the particles comprising at least

two electroconductive particulate products of different average particle sizes and wherein each particle of both the particulate products is coated with an electrically insulating resin insoluble in the insulating adhesive matrix. Note paragraph [0015] on page 3 of Yamada, et al. See also paragraphs [0022] and [0024] on page 4 of this patent document, describing the electroconductive particles, and paragraph [0029] on page 5 of this patent document, describing relative average particle sizes of the electroconductive particles. Note also paragraph [0031] on page 5 of this patent document, disclosing relative hardnesses of the smaller and greater average particle size particles. See also paragraphs [0076] and [0077] on page 10 of this patent document.

It is respectfully submitted that this reference does not disclose, nor would have suggested, the hardness of the conductive particles as in the present claims, particularly together with storage elastic modulus and mean coefficient of thermal expansion as in the present claims, and advantages achieved thereby. Moreover, this reference does not disclose, nor would have suggested, the glass transition temperature of the circuit connecting material as in various of the present claims, and advantages thereof. Noting, for example, Fig. 5 of this patent document, it can be seen that the terminals/circuit lines project above the surface of the substrate, and that this patent document does not address problems addressed by the present invention, nor solve such problems as achieved according to the present invention utilizing the conductive particles with hardness as in the present claims, the material having the storage elastic modulus and mean coefficient of thermal expansion as in the present claims.

Clearly Yamada, et al., providing connection between <u>different</u> structure than that of the present claims, would have neither disclosed nor would have suggested the <u>method</u> as in claim 19 and claims dependent thereon.

Suga, et al. discloses a semiconductor device having electrodes at a lower position than a passivation film, connected to a circuit board by connection material including adhesive components and conductive particles. This patent document discloses that the particles include a metal layer, the particles being of diameter d of not less than 1.5 times the height of the difference between the passivation film 5 and the electrodes 4 (note Fig. 1 of this patent document), and not more than 0.5 time the interval between the electrodes 4. Note also paragraphs [0007], [0015], [0016] and [0020] of this patent document, the latter paragraph describing the hardness of the conductive particles. Note also paragraph [0034] of this patent document, disclosing that where the hardness of the conductive particles is within ranges described in this patent, any possible damage to the passivation film can be prevented.

It is respectfully submitted that the Suga, et al. discloses a hardness for avoiding damage to the passivation layer. It is respectfully submitted that this reference does not disclose, nor would have suggested, conductive particles with a hardness in the range of the present claims, achieving sufficient deformation of the particles for achieving good electrical connection, with the material having the storage elastic modulus and mean coefficient of thermal expansion as in the present claims, the material having sufficient electrical connection and long-term reliability, as discussed previously.

Moreover, Suga, et al., and the other applied references, would have neither disclosed nor would have suggested the other features of the present invention as in the dependent claims, including the glass transition temperature, and advantages achieved thereby.

In addition, it is again noted that Suga, et al. discloses conductive particles of the recited hardness, to avoid damage to the passivation film which is made of resin.

Such disclosure would have taught away from the presently claimed material, which can be used in connection with structure including insulating layers of silicon dioxide or silicon nitride; and, in particular, such method as in the present claims, processing structure having insulating layers of silicon dioxide or silicon nitride located adjacent to at least one of the first and second circuit electrodes of the circuit members, with such circuit electrodes being connected utilizing the film-form circuit connecting material including the circuit connecting material of claim 1.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims in the above-identified application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 1303.45151X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

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Enclosures: Experimental Data with Additional Examples 1 and 2; Additional Reference Example 1; Additional Comparative Examples 1 and 2; Tables I-III

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Experimental Data

[Preparation of Materials]

<Phenoxy resin 2>

Phenoxy resin 2 was synthesized from bisphenol A type epoxy resin and 4, 4'-(9-fluorenylidene) diphenol. The weight average molecular weight of Phenoxy resin 2 measured by GPC in terms of polystyrene was 40000.

<Acrylic rubber 1>

Acrylic rubber 1 was synthesized from Butyl acrylate (50 parts by weight), Ethyl acrylate (30 parts by weight), Acrylonitrile (20 parts by weight) and Glycidyl methacrylate (2 parts by weight). The molecular weight of Acrylic rubber 1 was 850000. Acrylic rubber 1 (125 g) was soluted by ethyl acetate (400 g), and 30 % solution was prepared.

<Conductive Particles No. 18>

Core bodies of Conductive Particles No. 18 were obtained by mixing tetramethylolmethane tetraacrylate, divinylbenzene and a styrene monomer, performing suspension polymerization using benzoyl peroxide as a polymerization initiator. The core bodies were plated with an electroless Ni plating and Conductive Particles No. 18 were obtained. The mean particles size of core body was 5 μ m. The Ni plating thickness was 100 nm. The hardness of conductive particles was 2.9549 GPa (320 kgf/mm^2).

[Film-form circuit connecting material]

<Additional Example 1>

A film-form circuit connecting material of Additional Example 1 was produced like Example 1 excepting that using Phenoxy resin 2 instead of the phenoxy resin of Example 1.

<Additional Example 2>

A film-form circuit connecting material of Additional Example 2 was produced like Example 1 excepting that 15 g of a phenoxy resin, 35 g of Acrylic rubber 1 and 50 g of Novacure were added instead of that 30 g of a phenoxy resin, 30 g of bisphenol A type epoxy resin and 40 g of Novacure were added.

<Additional Reference Example 1>

A film-form circuit connecting material of Additional Reference Example 1 was produced like Example 1 excepting that using Conductive Particles No. 18 instead of Conductive Particles No. 1.

<Additional Comparative Example 1>

A film-form circuit connecting material of Additional Comparative Example 1 was produced like Example 1 excepting that using silica glass additionally.

<Additional Comparative Example 2>

A film-form circuit connecting material of Additional Comparative Example 2 was produced like Example 1 excepting that 15 g of a phenoxy resin, 55 g of Acrylic rubber 1 and 30 g of Novacure were added instead of that 30 g of a phenoxy resin, 30 g of bisphenol A type epoxy resin and 40 g of Novacure were added.

[Circuit member connecting structure 1]

Circuit member connecting structure 1 was produced by the same way described in [0132] to [0134] from the film-form circuit connecting material of Additional Examples.

<Bonding Strength>

The bonding strength were measured by 90 ° peel test with delaminating polyimide film by 50 mm/min. The bonding strength after 1000 hours in 80 ℃, 95%RH were also measured. And the storage elastic modulus at 40 ℃ and the mean coefficient of thermal expansion were measured. The results are shown in Table I. Table I shows also results of Examples 1-6 and Comparative Examples 1-10.

Table I

		Bonding Strength (N/cm)				storage elastic modulus at 40 ℃ (GPa)	mean coefficient of thermal expansion (ppm/℃)
		Two-layer FPC		Three layer FPC			
		initial	After 1000 hr in 80℃,95%RH	initial	After 1000 hr in 80℃,95%RH		
Example	1	7.2	2.1	9.8	4.4	1.8	60
	2	7.4	2.4	9.2	4.6		
	3	7.8	3.4	10.4	4.3		
	4	6.9	3.1	9.3	4.8		
	5	8.1	2.8	9.2	4.1		
	6	8.7	4.3	10.3	5.6		
Comparative Example	1	6.8	2.4	9.1	5.1	1.8	60
	2	7.2	2.5	9.4	4.6		
	3	7.6	2.3	9.1	4.6		
	4	8.1	2.8	9.8	4.2		
	5	7.6	2.1	10.2	4.8		
	6	7.5	2.6	9.5	4.1		
	7	7.8	3	9.7	4.3		
	8	7.4	2.7	9.8	4.7		
	9	7.3	2.4	9.9	4.5		
	10	7.1	2.3	9.1	4.2		
Additional Example	1	6.5	1.7	8.4	3.8	2.9	58
	2	8.9	5.6	10.3	5.9	0.8	110
Additional Reference Example	1	7.4	2.2	9.6	4.1	1.8	60
Additional Comparative Example	1	4.1	-	5.8	-	4.3	44
	2	5.8	2.8	6.1	4	0.4	220

In Additional Comparative Example 1, Bonding Strength could not be measured because the bonding agent had peeled away. This is because the storage elastic modulus at 40 ℃ (4.3 GPa) exceed 3 GPa and internal stress increased.

<Measurement of Connection Resistance and Counting of Conductive Particles>

The resistance values of the circuits were measured and the numbers of conductive particles that were present on the respective circuit electrodes were counted by the same way described in [0135] and [0136].

The results are shown in Table II.

Table II

Film-form circuit connecting material		Connecting structure using two-layer FPC			Connecting structure using three-layer FPC		
		Connection resistance (Ω)		Number of conductive particles on connected electrodes (number)	Connection resistance (Ω)		Number of conductive particles on connected electrodes (number)
		initial	After 1000 hr in 80℃,95%RH		initial	After 1000 hr in 80℃,95%RH	
Additional Example	1	0.9	1.7	7	1.98	2.55	7
	2	1.4	2.5	7	2.6	3.88	7
Additional Reference Example	1	1.8	3.9	8	2.8	5.4	8
Additional Comparative Example	1	0.7	1.1	6	1.6	2.33	6
	2	2.1	4.5	8	3.1	6.32	8

In Additional Reference Example 1, the connection resistances were higher than that of Examples. This is because the hardness of Conductive Particles No. 18 was lower than 4.4413 GPa.

In Additional Comparative Example 2, the connection resistances were higher than that of Examples. This is because the mean coefficient of thermal expansion was higher than 200 ppm /℃.

[Circuit member connecting structure 2]

Circuit member connecting structure 2 was produced by the same way described in [0141] to [0143] from the film-form circuit connecting material of Additional Examples.

<Measurement of Connection Resistance and Counting of Conductive Particles>

The resistance values of the circuits were measured and the numbers of conductive particles that were present on the respective circuit electrodes were counted by the same way described in [0144] and [0145]. The results are shown in Table III.

Table III

Film-form circuit connecting material		Connection resistance (Ω) initial	Connection resistance (Ω) After 1000 hr in 80℃,95%RH	Number of conductive particles on connected electrodes (number)
Additional Example	1	1	0.2	6
	2	1	0.9	6
Additional Reference Example	1	11	1.2	5
Additional Comparative Example	1	1	0.1	5
	2	210	>3	5

In Additional Reference Example 1, the connection resistances were higher than that of Examples. This is because the hardness of Conductive Particles No. 18 was lower than 4.4413 GPa.

In Additional Comparative Example 2, the connection resistances were higher than that of Examples. This is because the mean coefficient of thermal expansion was higher than 200 ppm /℃.

As shown above, the use of the circuit connecting material of the present invention makes it possible to achieve a sufficient reduction in the connection resistance and a sufficient bonding strength. And these effects are unexpected from the cited references.